

WHAT IS CLAIMED IS:

1. A thin film magnetic memory device, comprising:
a plurality of memory cells each having its electric resistance value
varying according to a storage data level written thereto by an applied
magnetic field;
- 5 a plurality of first data lines respectively provided for fixed
groupings of said plurality of memory cells, for reading said storage data
level in data read operation;
- 10 a plurality of source lines provided respectively corresponding to said
plurality of first data lines, and each electrically coupled to a corresponding
one of said plurality of first data lines through a selected one of the memory
cells in a corresponding fixed grouping in said data read operation;
- 15 a plurality of first data line selection portions provided respectively
corresponding to said plurality of first data lines, each of said plurality of
first data line selection portions precharging a corresponding one of said
plurality of first data lines to a first voltage before said data read operation,
and electrically disconnecting said corresponding first data line from said
first voltage in said data read operation; and
- 20 a plurality of source line selection portions provided respectively
corresponding to said plurality of source lines, each of said plurality of
source line selection portions including
 a source line precharging portion for precharging a
corresponding one of said plurality of source lines to a second voltage before
said data read operation, and
 a source line driving portion for electrically coupling said
corresponding source line to a third voltage in said data read operation.
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2. The thin film magnetic memory device according to claim 1,
wherein said first and second voltages are a same voltage.
3. The thin film magnetic memory device according to claim 2,
wherein said same voltage is the ground voltage.

4. The thin film magnetic memory device according to claim 1,
wherein

each of said memory cells has such characteristics that a difference
in electric resistance value resulting from a difference in said storage data
level is less likely to appear as a voltage applied to both ends of the memory
cell is increased,

said first and second voltages are a same voltage, and

each of said source line driving portions includes a first current
switch portion for forming a path of a prescribed passing current amount
between said corresponding source line and said third voltage to adjust a
change rate of a voltage on said corresponding source line in said data read
operation.

5. The thin film magnetic memory device according to claim 4,
wherein

each of said source line precharging portions includes a second
current switch portion electrically coupled between said corresponding
source line and said second voltage, and

5 said passing current amount of said first current switch portion is
smaller than that of said second current switch portion.

6. The thin film magnetic memory device according to claim 1,
wherein

said plurality of memory cells are arranged in a matrix,

5 said plurality of first data lines are provided respectively
corresponding to memory cell columns,

each of said first data line selection portions electrically disconnects
said corresponding first data line from said first voltage when a
corresponding memory cell column is selected for the data read operation,
and

10 the remaining first data lines of non-selected memory cell columns
are retained at said first voltage.

7. The thin film magnetic memory device according to claim 6,
further comprising a plurality of column selection lines provided
respectively corresponding to said memory cell columns, and each activated
and inactivated respectively in response to selection and non-selection of a
corresponding memory cell column, wherein

5 each of said first data line selection portions includes a transistor
switch electrically coupled between said corresponding first data line and
said first voltage, and turned ON and OFF in response to said activation
and inactivation of a corresponding column selection line, respectively.

8. The thin film magnetic memory device according to claim 1,
said plurality of memory cells are arranged in a matrix,
said plurality of source lines are provided respectively corresponding
to memory cell columns,

5 each of said source line selection portions electrically couples said
corresponding source line to said third voltage when a corresponding
memory cell column is selected for the data read operation, and

the remaining source lines of non-selected memory cell columns are
retained at said second voltage.

9. The thin film magnetic memory device according to claim 8,
further comprising a plurality of column selection lines provided
respectively corresponding to said memory cell columns, and each activated
and inactivated respectively in response to selection and non-selection of a
corresponding memory cell column, wherein

5 each of said source line driving portions includes a first transistor
switch electrically coupled between said corresponding source line and said
third voltage, and turned ON and OFF respectively in response to said
activation and inactivation of a corresponding one of said plurality of
column selection lines, and

10 each of said source line precharging portions includes a second
transistor switch electrically coupled between said corresponding source
line and said second voltage, and turned ON and OFF respectively in

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15 response to said activation and inactivation of said corresponding column selection line.

10. The thin film magnetic memory device according to claim 1, further comprising:

5 a second data line for transmitting a reference voltage to be compared with a voltage on a selected one of said plurality of first data lines corresponding to a memory cell selected for said data read operation;

a data read circuit for sensing and amplifying a voltage difference between the selected first data line and said second data lines;

10 a dummy memory cell having an intermediate electric resistance value of the electric resistance values of each memory cell respectively corresponding to the storage data levels;

a dummy source line provided corresponding to said second data line, and electrically coupled to said second data line through said dummy memory cell in said data read operation;

15 a second data line selection portion corresponding to said second data line; and

a dummy source line selection portion corresponding to said dummy source line, wherein

20 said second data line selection portion precharges said second data line to said first voltage before said data read operation, and electrically disconnects said second data line from said first voltage in said data read operation, and

said dummy source lines selection portion includes

25 a dummy source line precharging portion for precharging said dummy source line to said second voltage before said data read operation, and

a dummy source line driving portion for electrically coupling said dummy source line to said third voltage in said data read operation.

11. The thin film magnetic memory device according to claim 10, wherein an electric resistance value per unit length of said plurality of first

data lines and said second data line is designed so that the first data line in
a first current path including the memory cell selected for said data read
5 operation has a same electric resistance value as that of said second data
line in a second current path including said dummy memory cell, said first
and second current paths being formed between said data read circuit and
said third voltage.

12. The thin film magnetic memory device according to claim 10,
wherein

a plurality of second data lines are provided respectively
corresponding said plurality of first data lines,

5 each of said dummy source lines respectively corresponding to said
plurality of second data lines is provided as a wiring common to a
corresponding one of said plurality of source lines, and

each of said dummy source line selection portions respectively
corresponding to said dummy source lines is common to a corresponding
10 one of said source selection portions.

13. A thin film magnetic memory device, comprising:

a memory cell for storing data, wherein

each of said memory cells includes a magnetic storage portion having
its electric resistance value varying according to a storage data level, said
5 magnetic storage portion including

a first magnetic layer retaining a prescribed fixed
magnetization direction, and

10 a second magnetic layer retaining a magnetization direction
written according to combination of a first data write magnetic field for
applying a magnetic field in a hard magnetization axis direction and a
second data write magnetic field for applying a magnetic field in an easy
magnetization axis direction, said thin film magnetic memory device
further comprising:

15 a first signal line for passing therethrough a first data write current
generating said first data write magnetic field; and

a second signal line for passing therethrough a second data write current generating said second data write magnetic field, wherein supply of said first data write current is started prior to supply of said second data write current in data write operation.

14. The thin film magnetic memory device according to claim 13, wherein

said second signal line passes therethrough a data read current to be applied across said magnetic storage portion in data read operation, and

a time period from start of said data read operation until said data read current starts to flow through said second signal line is shorter than a time period from start of said data write operation until said second data write current starts to flow through said second signal line.

15. The thin film magnetic memory device according to claim 13, further comprising:

a third signal line electrically coupled to said second signal line through said memory cell in data read operation;

a first signal line selection portion for controlling a voltage on said second signal line; and

a second signal line selection portion for controlling a voltage on said third signal line wherein

said first signal line selection portion precharges said second signal line to a first voltage before said data read operation, and electrically disconnects said second signal line from said first voltage in said data read operation, and

said second signal line selection portion includes
a precharging portion for precharging said third signal line to
a second voltage before said data read operation, and

a signal line driving portion for electrically coupling said third signal line to a third voltage in said data read operation.

16. A thin film magnetic memory device, comprising:

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a plurality of memory cells arranged in a matrix, each of said plurality of memory cells including a magnetic storage portion having its electric resistance value varying according to a storage data level written therein by combination of first and second data write magnetic fields;

a plurality of write word lines provided respectively corresponding to memory cell rows, and selectively activated in data write operation to pass therethrough a first data write current for generating said first data write magnetic field;

10 a plurality of bit lines provided respectively corresponding to memory cell columns;

a plurality of source lines provided respectively corresponding to said memory cell columns, each of said plurality of source lines interposing the memory cells on a corresponding memory cell column between itself and a corresponding one of said plurality of bit lines;

15 a plurality of coupling switches provided respectively corresponding to said memory cell columns, for electrically coupling one of said plurality of source lines and one of said plurality of bit lines to each other at their respective one ends in said data write operation according to a column selection result; and

20 a data write circuit for supplying a second data write current for generating said second data write magnetic field in said data write operation, said data write circuit coupling, according to said column selection result, one of said plurality of source lines to one of first and

25 second voltages and one of said plurality of bit lines to the other voltage at the other ends according to said storage data level.

17. The thin film magnetic memory device according to claim 16, wherein each of said memory cells further includes an access portion selectively turned ON in data read operation to electrically couple said magnetic storage portion between a corresponding one of said plurality of bit lines and a corresponding one of said plurality of source lines, said thin film magnetic memory device further comprising:

5 a data read circuit for electrically coupling one of said source lines

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and one of said bit lines respectively to said first and second voltages at the
other ends in said data read operation according to said column selection
10 result, and conducting said data read operation based on a voltage change
on the bit line corresponding to said column selection result, wherein
said plurality of coupling switches electrically disconnect said
respective one ends of one of said source lines and one of said bit lines from
each other in said data read operation according to said column selection
15 result.

18. A thin film magnetic memory device, comprising:
a plurality of memory cells arranged in a matrix, each of said
plurality of memory cells including a magnetic storage portion having its
electric resistance value varying according to a storage data level written
by combination of first and second data write magnetic fields;
5 a plurality of write word lines provided respectively corresponding to
memory cell rows, and selectively activated in data write operation to pass
therethrough a first data write current for generating said first data write
magnetic field;
10 a plurality of source lines provided respectively corresponding to said
memory cell rows, and coupled to a first voltage at their respective one
ends;
a plurality of bit lines provided respectively corresponding to memory
cell columns, and selectively receiving a second data write current for
15 generating said second data write magnetic field in said data write
operation according to a column selection result; and
a word line driver for coupling the activated write word line to a
second voltage at its one end in said data write operation, wherein
said second data write current flows through a current path formed
20 from said activated write word line and at least one of said plurality of
source lines which is electrically coupled to said activated write word line at
the other ends.

19. The thin film magnetic memory device according to claim 18,

wherein

each of said plurality of write data lines is electrically coupled to one of said plurality of source lines corresponding to a same memory cell row at the other ends, and

said write word lines and said source lines are arranged such that magnetic fields respectively generated in said magnetic storage portion from said data write current flowing through the write word line and the source line have a same direction.

20. The thin film magnetic memory device according to claim 19, wherein each write word line and each source line are arranged so as to interpose said magnetic storage portion therebetween in a vertical direction.

21. The thin film magnetic memory device according to claim 18, further comprising a plurality of coupling switches respectively provided between each write word line and a plurality of source lines of other memory cell rows, wherein at least one coupling switch corresponding to said activated write word line is turned ON in said data write operation.

22. A thin film magnetic memory device, comprising:
a plurality of memory cells arranged in a matrix, each of said plurality of memory cells including

a magnetic storage portion having its electric resistance value varying according to a storage data level written therein by combination of first and second data write magnetic fields, and

an access portion coupled in series with said magnetic storage portion, and selectively turned ON in data read operation to pass a data read current therethrough and turned OFF in data write operation, said thin film magnetic memory device further comprising:

a plurality of read word lines provided respectively corresponding to memory cell rows, for turning ON said access portion in said data read operation according to a row selection result;

a plurality of write word lines provided respectively corresponding to

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- 15 said memory cell rows, and selectively activated to pass therethrough a first data write current generating said first data write magnetic field in said data write operation;
- 20 a plurality of bit lines provided respectively corresponding to memory cell columns, each of said plurality of bit lines being electrically coupled to said plurality of write word lines through said memory cells;
- 25 a word line driver for coupling the activated write word line to a first voltage at its one end and setting the remaining write word lines to a second voltage in order to supply a second data write current for generating said second data write magnetic field in said data write operation;
- 30 coupling switches respectively coupled between each write word line and a plurality of write word lines of other memory cell rows, each of the coupling switches being turned ON when one of the two write word lines coupled thereto is activated; and
- 35 a data read circuit for supplying said data read current to one of said plurality of bit lines in said data read operation according to a column selection result, and conducting said data read operation based on a voltage change on said bit line corresponding to said column selection result, wherein
 said word line driver sets each of said plurality of write word lines to a prescribed voltage in said data read operation.

23. A thin film magnetic memory device, comprising:

- a plurality of memory cells arranged in a matrix, each of said plurality of memory cells including
- 5 a magnetic storage portion having its electric resistance value varying according to a storage data level written therein, and
- an access portion selectively turned ON in data read operation to pass a data read current therethrough, said thin film magnetic memory device further comprising:
- 10 a plurality of data lines provided respectively corresponding to memory cell columns, for selectively receiving said data read current in said data read operation; and

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15 a plurality of reference voltage generating portions provided respectively corresponding to said memory cell columns, each of said plurality of reference voltage generating portions being selectively activated in said data read operation according to a column selection result to produce a reference voltage to be compared with a voltage on a corresponding one of said plurality of data lines, wherein
5 each of said plurality of memory cells is coupled between a corresponding one of said plurality of data lines and a prescribed voltage.

24. The thin film magnetic memory device according to claim 23, further comprising dummy data lines provided respectively corresponding said memory cell columns, for receiving said data read current when a corresponding memory cell column is selected for said data read operation, wherein each of said plurality of reference voltage generating portions includes

5 a dummy memory cell including a dummy resistance having an intermediate electric resistance value of the electric resistance values respectively corresponding to the storage data levels of each memory cell, and a dummy access portion electrically coupled in series with said dummy resistance between said corresponding one of said plurality of data lines and said prescribed voltage, and turned ON when a corresponding memory cell column is selected, and

10 15 a dummy selection portion for turning ON said dummy access portion when a corresponding memory cell column is selected for said data read operation.

25. The thin film magnetic memory device according to claim 24, wherein

5 two reference voltage producing portions are provided in every memory cell column,

each data line and each dummy data line are provided using two signal lines corresponding to a corresponding column, and
one of said two signal lines is electrically coupled to said memory cell

and the other is electrically coupled to said dummy memory cell according to a row selection result.

26. The thin film magnetic memory device according to claim 23, further comprising:

a plurality of source lines provided respectively corresponding to said plurality of data lines, each of said plurality of source lines being
5 electrically coupled to a corresponding one of said plurality of data lines through a selected memory cell of a same memory cell column in said data read operation;

a plurality of data line selection portions provided respectively corresponding to said plurality of data lines; and

10 a plurality of source line selection portions provided respectively corresponding to said plurality of source lines, wherein

each of said plurality of data line selection portions precharges a corresponding one of said plurality of data lines to a first voltage before said data read operation, and electrically disconnect said corresponding bit line from said first voltage in said data read operation, and

15 each of said plurality of source line selection portions includes a source line precharging portion for precharging a corresponding one of said plurality of source lines to a second voltage before said data read operation, and

20 a source line driving portion for electrically coupling said corresponding source line to said prescribed voltage in said data read operation.